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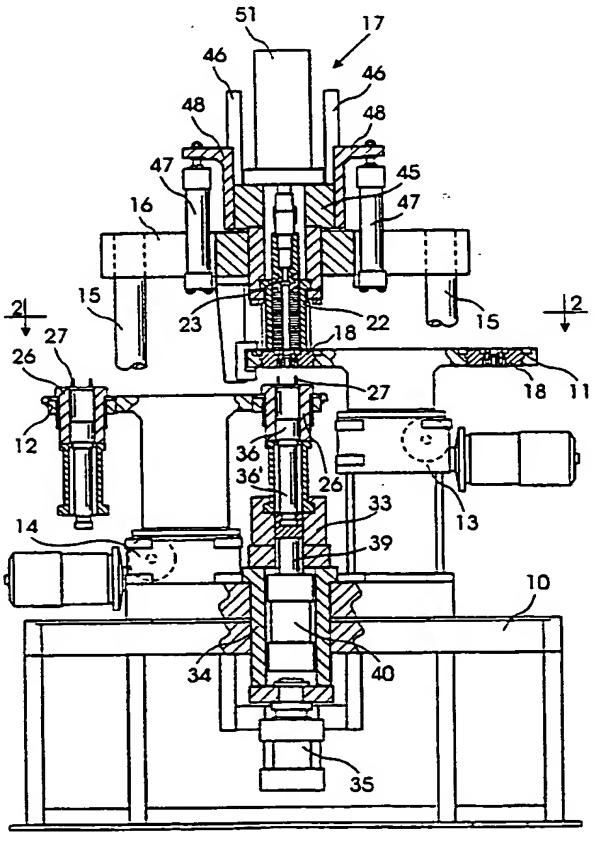
(54) Title: VERTICAL DIE-CASTING PRESS



(57) Abstract: The vertical die-casting press comprises an upper and a lower rotating table (11, 12), partially superimposed each other and supported to rotate; an upper die member (23) is provided for a vertical movement towards the superimposed tables (11, 12), and angularly spaced apart of bottom die members (18), are floatingly supported by the upper table (11), to be moved along a first circular path. Injection sleeves and shot plungers (26, 36) are also provided on the lower table (12) to move along a second circular path. Each injection sleeve (26) and the associated shot plunger (36) are vertically movable between a lowered position, and a raised position in contact with a bottom die member (18) to close a mold. The tables (11, 12) are stepwise rotated to position in sequence each bottom die member (18), and each injection sleeve (26) in alignment with the upper die member (23) in the metal injection station (B2) of the press.

WO 01/05537 A1

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VERTICAL DIE-CASTING PRESS

BACKGROUND OF THE INVENTION

The present invention relates to vertical die-casting machine for casting of metal parts, and more particularly concerns a vertical die-casting press for casting aluminium rotor cages directly inside the slots of rotor laminations of an electric motor, or for other similar applications.

In particular, the invention concerns a vertical die-casting press for casting metal parts into a die mold comprising upper and bottom die members, a plurality of injection sleeves provided on a first rotating table, and a shot plunger sliding in each injection sleeve, in which the injection sleeves can be moved in sequence between a molten-metal feeding station, and a molten-metal injection station where each injection sleeve is aligned with an upper die member, and in which each injection sleeve and the associated shot plunger are engageable with and disengageable from respective actuators by a rotation of the same table supporting the injection sleeves.

PRIOR ART

Die-casting presses of the vertical type for casting of metal pieces, are well known and for some time have been widely used for many applications.

Presses of this type may have a single injection sleeve which is tiltable or supported by a sliding plate to be moved between a molten-metal receiving station for filling the sleeve with a metered quantity of the molten material, and a metal injection station where the molten-metal is injected under pressure into the cavity of a mold; presses

of this kind are shown, for example, in US-A-4,088,178.

Vertical die-casting presses of rotatable type, provided with several workstations have also been proposed in which a mold supporting table or an injection sleeve supporting table is made to rotate stepwise so as to bring each mold, or each injection sleeve, into a plurality of work stations where various operations are performed on a same mold or workpiece; examples of this type of presses are described in US-A-3,866,666 and US-A-5,660,223.

In particular, US-A-3,866,666 describes a die-casting press with a single rotating table for casting rotors for electric motors, in which a pack of laminations provided with longitudinal slots for the injection of a molten-metal is loaded and sealingly clamped or pressed between an upper die member fixed to a rotating table and a respective bottom die member movably supported by the same rotating table for a vertical movement in respect to the upper member of the mold. The vertical movement of an injection sleeve, and the closure of the die members against the laminations are accomplished by exerting a strong clamping force by means of a first hydraulic cylinder provided in a fixed metal injection station, while the injection of the molten-metal from the sleeve into the mold is achieved by a shot plunger which is sliding inside the sleeve and which is connected to a second hydraulic actuator mounted on the piston rod of the first hydraulic cylinder and movable therewith.

Presses of this kind have some working limitations and drawbacks due to both the difficulty in achieving a complete automation of the work cycle, and the duration of the same work cycle which is still considered to be excessive since the operations for filling the injection

sleeve and injecting the molten-metal into the mold are performed in successive times in a same fixed workstation of the casting machine; moreover, the fact that both the upper and bottom die members are supported by a same rotating table, results in the mold closing thrusts being directly transmitted to the rotational axis of the same table, adversely affecting a correct operation thereof.

Conversely, US-A-5,660,223, which represents the prior art closest to the present invention, illustrates a die-casting press comprising a frame, a table supported by the frame for rotation and a plurality of angularly spaced apart shot sleeves each provided with a shot piston, and a gate member adjacent said table for supporting a mold; a hydraulic cylinder and a power driven are provided for clamping the mold against the gate member and for urging the same gate member against the sleeve, respectively for moving the table to reciprocate the shot sleeve between a metal receiving station and a metal transfer station of the machine. According to the same document, in each of the two workstations, each shot piston can be coupled in a disengageable manner, with a respective actuating cylinder, to allow at the same time, the charging of the molten-metal into a sleeve, and the injection of the molten-metal into the mold form another sleeve, as well as the ejection as a sprue from a sleeve in the same metal receiving station of the machine.

Although US-A-5,660,223 aims to reduce the work cycle of the press, by reducing the weight of the mass moved on the rotating table, this document does not adequately solve the problem of automation of the press, since all the working operations involving cleaning of the mold, loading of the laminations, injection of the molten-metal demolding of the cast rotor and removal of the sprue, are performed on a

same rotating table performing several of said operations in a same single workstation, thereby needlessly increasing the working cycle times. Moreover, in this type of press also, all the mold closing forces are transmitted again to the rotational axis of the table producing high bending moments which, with prolonged use, may result in deformations and malfunctioning.

OBJECTS OF THE INVENTION

An object of the present invention is to provide a vertical die-casting press of the kind referred to, particularly useful for die-casting rotor cages for electric motors, by which it is possible to achieve a greater automation degree, and in which the mold closing forces are directly transmitted to and entirely supported by the structure of the press.

A further object of the present invention is to provide a vertical die-casting press of the type mentioned above, in which the several working operations during a working cycle, are simultaneously performed in corresponding and separate workstations or positions, thus allowing a substantial time reduction in the work cycle while keeping a simplified construction of the press.

BRIEF DESCRIPTION OF THE INVENTION

The above may be achieved by means of a vertical die-casting press useful for casting metal piece by injecting a molten-metal into the cavities of die molds provided by upper and bottom die members, the press comprising:

a vertically extending frame;

an upper rotating table and a lower rotating table which are partially superimposed each other and supported

to rotate on a respective vertically extending axis;

an upper die member supported for a vertical movement towards the superimposed tables;

a plurality of bottom die members angularly spaced apart each other on the upper rotating table, to be moved and positioned in sequence, underlying and aligned with the upper die member, in molten-metal injection station of the press;

a plurality of vertically extending injection sleeve and shot plunger units, angularly spaced apart each other on the lower rotating table, to move along, in sequence, underlying and aligned with a bottom die-member in the molten-metal injection station of the press;

each injection sleeve and the associated shot plunger being vertically movable on the lower table between a lowered position in which the injection sleeve is spaced apart from the upper table, and a raised position where the injection sleeve is in contact with a bottom die member of the mold;

power actuators for moving stepwise the upper and the lower rotating tables so as to position in sequence each bottom die member, and respectively each injection sleeve, in the aligned condition with the upper die member in metal injection station of the press;

first and second hydraulic cylinders underneath said injection station, being selectively actuable and provided with couplings so as to automatically engage and disengage, by rotation of the lower table, each injection sleeve and the associated shot plunger in the metal injection station, and to sealingly close and inject the molten-metal into a mold.

According to a particular embodiment of the invention, a vertical die-casting press as been provided for casting rotor cages of electric motors by injecting a molten-metal

into the cavities of laminations pressed between upper and lower die members of casting molds positioned in a metal injection station of the press, comprising:

a bottom frame and an upper cross member supported by vertically extending rods;

a first rotating table on the bottom frame, provided with a plurality of angularly spaced apart injection sleeves, and a shot plunger sliding in each injection sleeve;

first indexing power actuator for moving stepwise the first rotating table to position in sequence each injection sleeve in an aligned condition with a metal feeding station, respectively with said metal injection station of the press; and

hydraulic actuators positioned in alignment with the metal injecting station and a sprue ejection station, which can be selectively coupled, in a disengageable manner, with each shot plunger and each injection sleeve in said metal injection station, respectively with each shot plunger in said sprue ejection station of the press, wherein:

each injection sleeve and the associated shot plunger are movably supported in a vertical direction between a lowered position to allow rotation of the first rotating table, and a raised position where the injection sleeve is in contact with a bottom die member of a mold; and

wherein a second rotating table is provided above and partially superimposed to the first rotating table, in said metal injection station;

the second rotating table comprising a plurality of bottom die members which are supported in a floating manner, for a short vertical movement towards the upper die member;

second indexing power actuator being provided for moving stepwise the second rotating table to position in sequence each bottom die member in alignment with the upper

die member and a metal injection sleeve in the metal injection station of the die-casting press;

a plurality of working stations being peripherally arranged around the first and second rotating tables, said working stations comprising a metal feeding station, the metal injection station and a sprue ejection station along a first circular path for the sleeves on the first rotating table, as well as comprising the metal injection station, rotor charging and rotor decharging stations along a second circular path for the bottom die members on the second rotating table, respectively.

According to a preferred embodiment, in the casting the rotor cages of electric motors, the first rotating table is provided with four bottom die members which are angularly spaced at 90°, to be conjointly aligned with corresponding working stations along said first circular path where the following operations are simultaneously performed: loading of rotor laminations (A1); closure of the mold and injection of the molten-metal into the mold (A2); removal of the cast rotor (A3), cleaning and/or lubrication of the bottom dies (A4).

Correspondingly, the second rotating table is provided with four injection sleeves which extend underneath the rotating table, angularly spaced at 90° to be conjointly aligned with corresponding working stations to perform the following operations simultaneously: filling a sleeve with a metered quantity of molten-metal in a first working station (B1); raising of a sleeve towards a bottom die, member to close a mold and to inject the molten-metal in the injection station (B2), where the sleeve and the shot plunger are automatically coupled, in a disengageable manner, with respective actuating cylinders; separation of the sprue from a bottom die member, and withdrawal of the

sprue inside the sleeve in the same injection station, followed by ejection and discharge of the sprue from the injection sleeve, in a successive working station (B3) where the sleeve is automatically coupled, in a disengageable manner, with a retaining member, while the shot plunger is automatically coupled, in a disengageable manner, with an actuating cylinder underneath the said second rotating table supporting the injection sleeves; cleaning and lubrication operations of the sleeves are thereafter performed in a fourth station (B4) of the machine.

One of the most relevant features of the present invention, in addition to the partially superimposed disposition of the rotating tables of the press, therefore resides in the floating support of the bottom die members so as to allow them a short vertical movement sufficient to compensate for the clearance of the mold, thus allowing all the reaction forces to be directly discharged on the frame structure of the press without subjecting the rotating tables and their rotational axis to excessive stresses.

BRIEF DESCRIPTION OF THE DRAWINGS

These and further features of a vertical die-casting press according to the present invention, as well as a preferred embodiment thereof, will emerge more clearly from the following description with reference to the accompanying drawings, in which:

Fig. 1 is a partially sectioned front view of the press;

Fig. 2 is a view along the line 2-2 of Fig. 1;

Fig. 3 is an enlarged detail of Figure 1;

Fig. 4 is an enlarged detail of the upper rotating table, showing the system for supporting a bottom die

member in a floating manner;

Fig. 5 shows in detail the coupling of an injection sleeve with a respective actuating cylinder, seen along the cross-sectional line 5-5 in Figure 3;

Fig. 6 shows a further enlarged detail of the press according to Figure 1.

DETAILED DESCRIPTION OF THE INVENTION

As shown in the views of Figures 1 and 2, the press substantially comprises a support frame 10 for an upper rotating table 11, and for a lower rotating table 12 provided in a position underneath and partially superimposed with respect to the upper rotating table 11. Each table 11 and 12 is indexed or made to rotate stepwise by means of a powered actuated control unit 13 and 14, respectively, which supports the same table to rotate on a vertical axis.

The frame structure 10 of the press extends upwards, beyond the rotating tables 11 and 12, by columns 15 connected by a cross-piece 16 to support a control unit 17 for raising and lowering an upper die member 23 of a mold into which a metered quantity of a molten-metal, for example aluminium, must be pressure injected in order to form a metal cast or piece, such as the cage of a rotor for electric motors, as explained further below.

The rotating tables 11 and 12 may have any desired shape; preferably, as shown in Figure 2, they are in the form of a Maltese cross having four diametrically opposite arms for supporting a corresponding number of bottom die members 18 and metal injection sleeves 26, respectively.

In particular, the upper rotating table 11 is provided to

support four bottom die members 18 which are angularly spaced at 90° each other and which may be sequentially moved along a circular path into the various workstations A1, A2, A3 and A4 where various operation are performed; in the case of die-casting of rotors, the following operations are simultaneously performed:

A1 - loading of a pack of laminations P onto a bottom die member 18, picking up the laminations from a conveyor 20 by means of a rotating arm 21;

A2 - in this station, a pack of laminations P which has been previously loaded, on a bottom die member 18, is firstly enclosed inside a peripheral sleeve 22 (Figure 1) which is supported by the upper unit 17 together with the upper die member 23 (Figure 1). The axially aligned upper and bottom die members 18, 23 together with the sleeve 22, in this station define overall a mold for the injection of a metered quantity of a molten-metal into slots of laminations P, as explained furtheron;

A3 - in this station, each cast rotor R is removed from each bottom die member by a rotating arm 24 so as to be deposited on a conveyor 25 on the side of the press opposite to that of the conveyor 20;

A4 - in this station, final operations involving cleaning and lubrication of the bottom die member 18, after discharging of the cast rotors R, are performed.

Correspondingly, the lower rotating table 12, positioned underneath the upper table 11, supports four injection sleeves 26 which are angularly spaced at 90° and which may be moved in sequence along a respective circular path into the four working stations B1, B2, B3 and B4, the station B2 coinciding with the station A2 of the rotating table 11, in which the injection of the molten-metal into the mold, occurs.

At the same time as the operations performed in A1-A4 on the upper table 11, the following operations are performed on the lower table 12:

B1 - in this station, a metered quantity of molten-metal from a melting furnace, not shown, located next to the press is poured into an injection sleeve 26;

B2 - in this station, upon rotation of the upper table 12, coupling of each injection sleeve 26 and shot plunger 36 with the respective actuating cylinders 35, 40 is sequentially performed; as shown, the cylinders 35, 40 are stationary and supported by the frame 10 of the machine, in alignment with the upper die member 23 defining the injection station of the press. In B2 raising of a sleeve 26 against a bottom die member 18 is firstly performed to tightly close the mold, than the molten-metal is injected into mold through respective sprue apertures in the bottom die member as shown; lastly in B2 once a cooling period has lapsed, opening of a mold is performed by raising the upper die member 23 and sleeve 22, as well as by lowering of the injection sleeve 26 and the associated shot plunger 36, thus causing separation of the sprue cast 27 from the bottom die member 18 and withdrawal of the same sprue 27, into the injection sleeve 26;

B3 - ejection of the sprue 27 from the injection sleeve 26 and discharging of the same onto a chute 28 by means of a side pushing member 29 actuated by cylinder 29' is performed, as shown in Figure 6;

B4 - in this latter station, operations involving cleaning and lubrication of each injection sleeve 26 are performed before the same sleeve is returned to the metal feeding station B1.

As mentioned above, each injection sleeve 26, in the metal injection station B2, is movable between a lowered

position, shown in Figures 1 and 3, where the sleeve is spaced apart from the overlying table 11 to allow rotation of the same, and a raised position where the said sleeve 26 is in contact with a bottom die member 18 on the rotating table 11, in alignment with the upper die member 23 of a mold.

In this connection, each injection sleeve 26 is guided during its vertical movement by a guide bush 30 which extends downwards from the rotating table 12.

As shown in figure 3, a tubular member 31 extends downwards form each injection sleeve 26, and is provided at its bottom end with a hooking flange 32 of substantially square shape, designed to engage and disengage, during rotation of the table 12, with a first hooking member provided by two side brackets 33 mounted at the upper end of a support bush 34 connected to the piston rod of the actuating cylinder 35.

Inside each injection sleeve 26 slide a shot plunger 36, the rod 36' of which extend into the tubular member 31 and terminates in an enlarged head 37 to engage, during rotation of the table 12, with a second hooking member 38 provided at the upper end of the piston rod 39 of the second actuating cylinder 40 coaxially arranged to the cylinder 35, and fastened inside the support bush 34.

Both hooking members 33 and 38 are tangentially arranged on the circular path of the injection sleeves 26 and shot plungers 36, and are open at their opposite ends. It is therefore evident that, during rotation of the table 12, each injection sleeve 26 and the respective shot plunger 36 when they reach the injection station B2, automatically engage with the hooking members 33 and 38 of the respective

actuating cylinders 35 and 40, so as to sequentially allow the raising of the sleeve 26 sealingly against an overlying die member 18, and raising of the plunger 36 to inject the molten-metal into the mold. At the successive step rotation of the table 12, in the same direction, the injection sleeve and shot plunger automatically disengage from hooking members 33 and 38.

In the same manner as occurs in the injection station B2, also in the station B3 for removal of the sprue 27, see Figure 6, each injection sleeve 26 engages with a fixed hooking member 41 provided by two side jaws similar to the jaws 33 of Fig. 5, while the head 37 at the bottom end of the rod 36' of the shot plunger 36, engages with a hooking member 42 provided at the upper end of the rod of a hydraulic cylinder 43.

As mentioned above, in this station B3 the sprue 27, which in B2 has been previously removed from the bottom die member 18 and retracted, by lowering the sleeve 26 and the shot plunger 36, in a manner per se known, is ejected from the sleeve 26 and then pushed towards the chute 28 by the pushing member 29 actuated by the respective cylinder 29'.

With reference again to Figure 1, it can be seen that the control unit 17 for raising and lowering the upper die member 23, and the peripheral sleeve 22, comprises a sliding member 45 for removably supporting the sleeve 22; the sliding member 45 is vertically movable along guide rods 46, and is in turn connected to two actuating cylinders 47 by brackets 48 so as to be moved between a totally raised position, where the sleeve 22 is above the laminations of a cast rotor, so as to allow rotation of the table 11 and demolding, and a totally lowered position with the sleeve 22 against an underlying die member 18, where

said sleeve 22 encloses a pack of laminations 50, as shown in the enlarged detail of Figure 3. The sliding member 45 for supporting the sleeve 22 and the upper die member 23, may be retained in the lowered position, before definitive closing of the mold, by means of locking devices, not shown, in a manner known per se.

The sliding member 45 of the unit 17 in turn supports a hydraulic cylinder 51 to control the position of the upper mold member 23 inside the sleeve 22, to adjust the latter according to the height of the pack of laminations 50 of the rotor to be cast.

Finally, with reference to Figure 4, a further feature of the vertical press according to the invention will be described.

As mentioned above, one of the objects of the invention is to completely free the rotating tables 11 and 12 from any stress caused at the closure of the mold during injection of the molten-metal.

With regard to the table 12 supporting the injection sleeves, this is achieved, in a mode per se known, by supporting the sleeves 26 in an axially sliding manner with respect to the same table 12.

With regard to the table 11 this is achieved by supporting the bottom die members 18 in a freely floating manner, allowing each die member 18 to perform a short vertical movement under the thrusting force of the injection sleeve 26, towards the housing sleeve 22 for the laminations, and towards the upper die member 23 of the mold.

As shown in the enlarged detail of Figure 4, each bottom

die member 18 has an annular flange 52 which rests against an annular shoulder 53 of a seat in the same rotating table 11. The annular flange 52 has a thickness which is less than the height of the seat so as to allow a small clearance 54 with respect to a stop ring 55 slightly protruding from the table 11, to allow the desired vertical movement.

The clearance 54 existing between the annular flange 52 and the stop ring 55 must be equal to or slightly greater than the existing clearance of the control unit 17 for raising and lowering the upper die member 23, so as to prevent any contact between the flange 52 of each bottom die member 18, and the respective upper stop ring 55.

In this way, all the forces exerted by the cylinders 35 and 40 against the bottom die member 18, upon the closure of a mold and injection of the molten-metal, are entirely transmitted to the frame structure 10, 16 of the press through a bottom die member 18, the sleeve 22, the upper die member 23 and the control unit 17, thus completely freeing the two rotating tables 11 and 12.

The operative cycle of the press is briefly as follows: starting from the condition shown in Figure 2, the table 11 is made to rotate in the anti-clock direction, so as to move sequentially the various bottom die members 18 from the position A1 to the position A2, and then to the positions A3 and A4, as shown; at the same time the table 12 is made to rotate in the clock direction so as to move the various injection sleeves 26, from the position B1 to the position B2, and then to the position B3 and B4.

Since the various steps of the press work cycle have been divided up among several workstations, on two different

tables 11, 12, they may be conjointly performed, helping to substantially reduce the overall cycle time.

More precisely, while on the table 11 a loading operation for a pack of laminations 50 into the station or position A1 is performed by the arm 21, at the same time, on the same table, the operation involving closure of a mold against a bottom die member 18, for injection of the molten-metal may be performed in the position A2, as well as the operation involving unloading of a cast rotor R or more generally a cast piece is performed in the position A3 by the arm 24 which pick up the rotor R to move the same onto the conveyor belt 25; lastly a final operation involving cleaning and lubrication of the die members 18 is performed in the position A4.

At the same time, on the table 12 the following operations are simultaneously performed: charging of a metered quantity of molten-metal into a sleeve 26 in the position B1; raising of the sleeve 26, against a bottom die member 18 on the table 11 to close a mold, and subsequent injection of the molten-metal in the position B2. Solidification of the metal injected into the mold, and separation of the sprue are still performed in the position B2, while ejection of a sprue 27 from a sleeve 26 and discharging of the same sprue 27 onto the chute 28 is made in the position B3; finally, cleaning and lubrication of the sleeves are performed in the position B4.

Upon stoppage and start-up of each rotational step of the table 12, the actuating cylinders 35, 40 and 43 are coupled with and automatically disengaged from the sleeves 26 and shot plungers 36 in the positions B2 and the B3. More precisely in the position B2 on the table 12, which corresponds to the position A2 on the tables 11, automatic

coupling of each sleeve 26 and associated shot plunger 36 with the hooking members 33 and 38 of the actuating cylinders 35 and 40 occurs. Similarly, in the position B3, the sleeve 26 engages with the fixed hooking member 41, while the head 37 at the bottom end of a rod 36' of a shot plunger 36 engages with the hooking member 41 of the actuating cylinder 43 to eject the sprue 27.

Once the cycle has been completed, each bottom die member 18 and each injection sleeve 26 are moved again in positions A1 and B1, respectively, so as to start a new work cycle.

In the example described above, the two tables 11 and 12 are made to rotate in opposite directions each other; as alternative solution, by reversing the disposition of the working stations on one of the tables, both tables 11, 12 may be rotated in a same direction, without involving any substantial change.

From what has been said and illustrated in the accompanying drawings it will therefore be understood that it has been possible to provide a vertical die-casting press for casting metal parts and in particular for casting the short-circuit cages of rotors for electric motors, by means of which the objects o the present invention may be achieved.

However, it is understood that the above description and illustration with reference to the accompanying drawings has been provided purely by way of example of a vertical die-casting press according to the invention, and that other modifications or variations may be made without thereby departing from the appended claims.

CLAIMS

1. A vertical die-casting press for casting metal pieces by injecting a molten-metal into the cavities of die mold provided by upper and bottom die members (22, 18), comprising:

a vertically extending frame (10, 16);

an upper rotating table (11); and

a lower rotating table (12), which are partially superimposed each other and supported to rotate on a respective vertically extending axis;

an upper die member (23) supported for a vertical movement towards the superimposed tables (11, 12);

a plurality of bottom die members (18) angularly spaced apart each other on the upper rotating table (11), to be moved and positioned in sequence, underlying and aligned with the upper die member (23), in molten-metal injection station of the press;

a plurality of vertically extending injection sleeve and shot plunger units (26, 36), angularly spaced apart each other on the lower rotating table (12), to move along, in sequence, underlying and aligned with a bottom die-member (18) in the molten-metal injection station of the press;

each injection sleeve (26) and the associated shot plunger (36) being vertically movable on the lower table between a lowered position in which the injection sleeve (26) is spaced apart from the upper table (11), and a raised position where the injection sleeve (26) is in contact with a bottom die member (18) of the mold;

power actuators (13, 14) for moving stepwise the upper and the lower rotating tables (11, 12) so as to position in sequence each bottom die member (18), and respectively each injection sleeve (26), in the aligned condition with the upper die member (23) in metal injection station of the

press;

first and second hydraulic cylinders (35, 40) underneath said injection station, being selectively actuable and provided with couplings (33, 38) so as to automatically engage and disengage, by rotation of the lower table (12), each injection sleeve (26) and the associated shot plunger (33) in the metal injection station, and to sealingly close and inject the molten-metal into a mold (18, 22, 23).

2. A vertical die-casting press according to claim 1, wherein said bottom die members (18) are floatingly supported by the upper rotating table (11) for a short vertical movement towards the upper die member (22) of the press.

3. A vertical die-casting press according to claim 1, wherein each injection sleeve (26) and associated shot plunger (36) are engageable and disengageable, by rotation of the bottom table (12) with a retaining member (33) and a coupling (38) of a third hydraulic cylinder (43) in a sprue discharging station (B3) angularly spaced apart from and positioned between the metal injection station (A2, B2) and a metal feeding station (B1) provided around a circular path of the injection sleeves (26).

4. A vertical die-casting press according to claim 1, wherein the bottom die members (18) are movable along a circular path comprising at least said metal injection station (A2, B2) for the upper rotating table (11) of the press.

5. A vertical die-casting press according to claim 1, wherein said power actuators (13, 14) are operated to stepwise rotate the upper tables (11) for the bottom die-

members (18), in an opposite direction with respect to the lower table (12) for the injection sleeves (26).

6. A vertical die-casting press according to claim 1, wherein said power actuators (13, 14) are operated to stepwise rotate the upper and lower tables (11, 12) in a same rotational direction for the bottom die members (18) and injection sleeves (26) of the press.

7. A vertical die-casting press according to claim 1, wherein said bottom die members (18) are provided with sprue holes for injecting the molten-metal from an underlying injection sleeve, into a mold.

8. A vertical die-casting press according to claim 1, wherein the upper die member (26) is adjustably supported by a sliding member (45), in respect to the bottom die members (18) on the upper rotating table (11) of the press.

9. A vertical die-casting press according to claim 1, wherein each bottom die member (18) is movably supported by the upper table (11), between and annular shoulder (53) in a seating, and an upper stop ring (55).

10. A vertical die-casting press according to claim 1, wherein said coupling comprises hooking members (33, 38) tangentially arranged on a circular path for the injection sleeves (26) and the shot plungers (36) respectively, along a circular path beneath the lower table (12) of press.

11. A vertical die-casting press according to claim 1, wherein the vertical movement for each bottom die member (18) on the upper table (11), is greater than the clearance existing between movable parts of a control unit (17) for movement of the upper die member (23) of the press.

12. A vertical die-casting press according to claim 1, wherein each power actuator for stepwise moving the upper and lower tables (11, 12) comprises a motor driven indexing device (13, 14).

13. A vertical die-casting press for casting rotor cages of electric motors by injecting a molten-metal into the cavities of laminations (50) pressed between upper and lower die members (18, 23) of casting molds positioned in a metal injection station (A2) of the press, comprising:

a bottom frame (10) and an upper cross member (16) supported by vertically extending rods (15);

a first rotating table (12) on the bottom frame (10), provided with a plurality of angularly spaced apart injection sleeves (26), and a shot plunger (36) sliding in each injection sleeve (26);

first indexing power actuator (14) for moving stepwise the first rotating table (12) to position in sequence each injection sleeve (26) in an aligned condition with a metal feeding station (B1), respectively with the metal injection station (A2) of the press; and

hydraulic actuators (35, 40, 43) positioned in alignment with the metal injecting station (B2) and a sprue ejection station (B3), which can be selectively coupled, in a disengageable manner, with each shot plunger (36) and each injection sleeve (26) in said metal injection station (B2), respectively with each shot plunger (36) in said sprue ejection station (B3) of the press, wherein:

each injection sleeve (26) and the associated shot plunger (36) are movably supported in a vertical direction between a lowered position to allow rotation of the first rotating table (12), and a raised position where the injection sleeve (26) is in contact with a bottom die member (18) of a mold; and

wherein a second rotating table (11) is provided above

and partially superimposed to the first rotating table (12), in said metal injection station (B2);

the second rotating table (12) comprising a plurality of bottom die members (18) which are supported in a floating manner, for a short vertical movement towards the upper die member (23);

second indexing power actuator (13) being provided for moving stepwise the second rotating table (12) to position in sequence each bottom die member in alignment with the upper die member (23) and a metal injection sleeve (26) in the metal injection station (A2) of the die-casting press;

a plurality of working stations (A1-A4; B1-B4) being peripherally arranged around the first and second rotating tables (11, 12), said working stations comprising a metal feeding station (B1), the metal injection station (B2) and a sprue ejection station (B3) along a first circular path for the sleeves (26) on the first rotating table (12), as well as comprising the metal injection station (A2), rotor charging and rotor decharging stations (a1, A3) along a second circular path for the bottom die members (18) on the second rotating table (11), respectively.

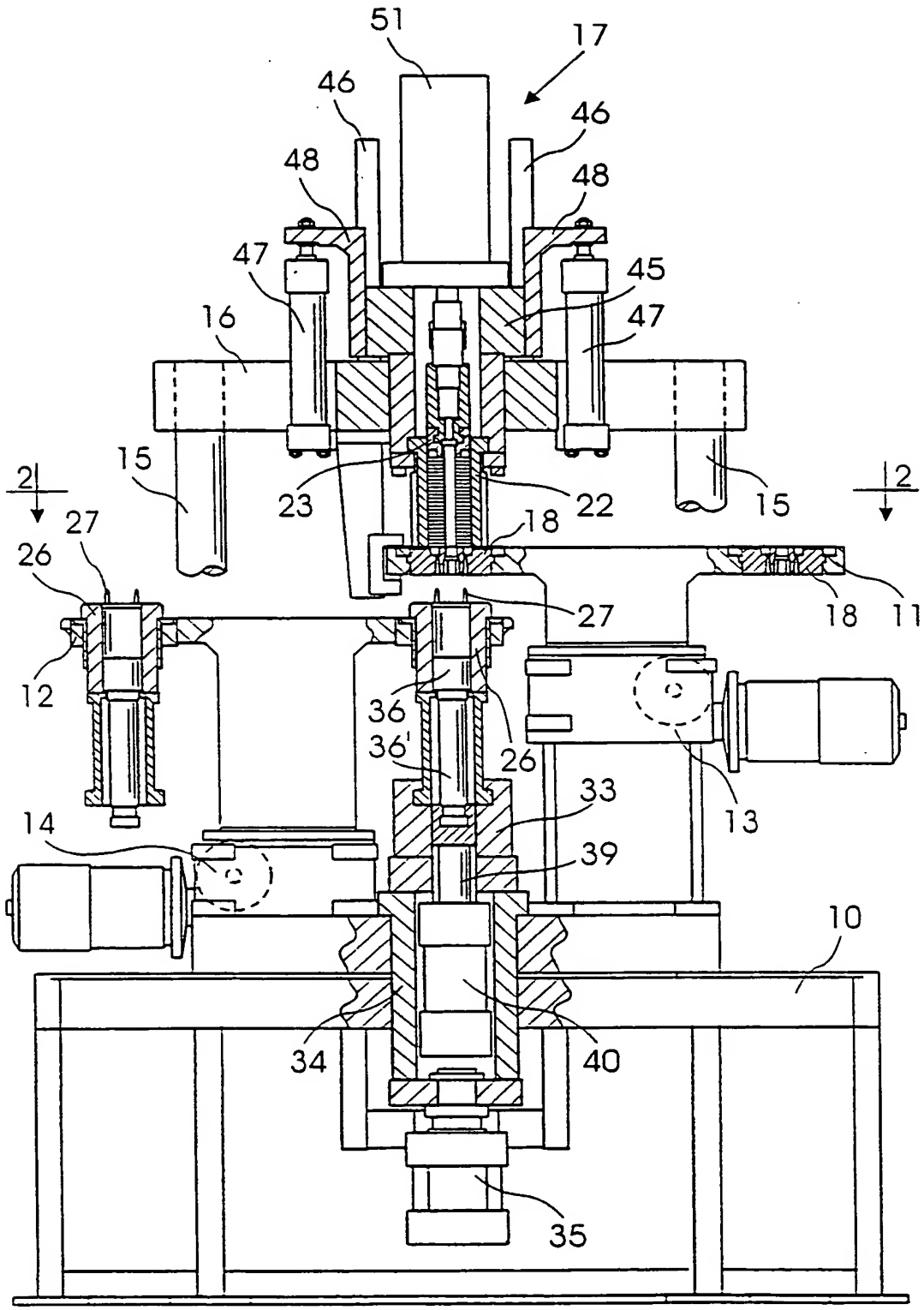
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Fig. 1

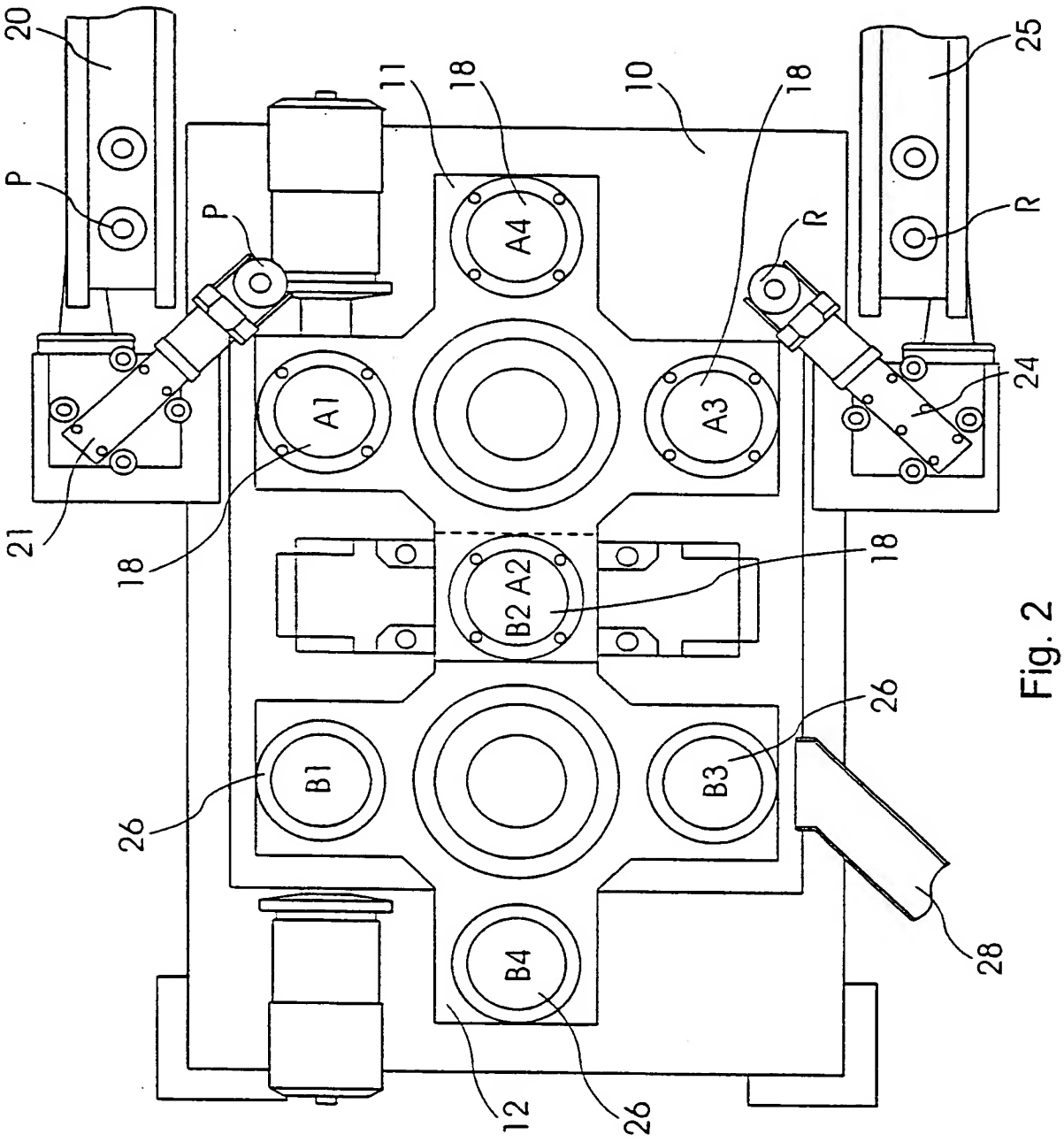
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Fig. 2

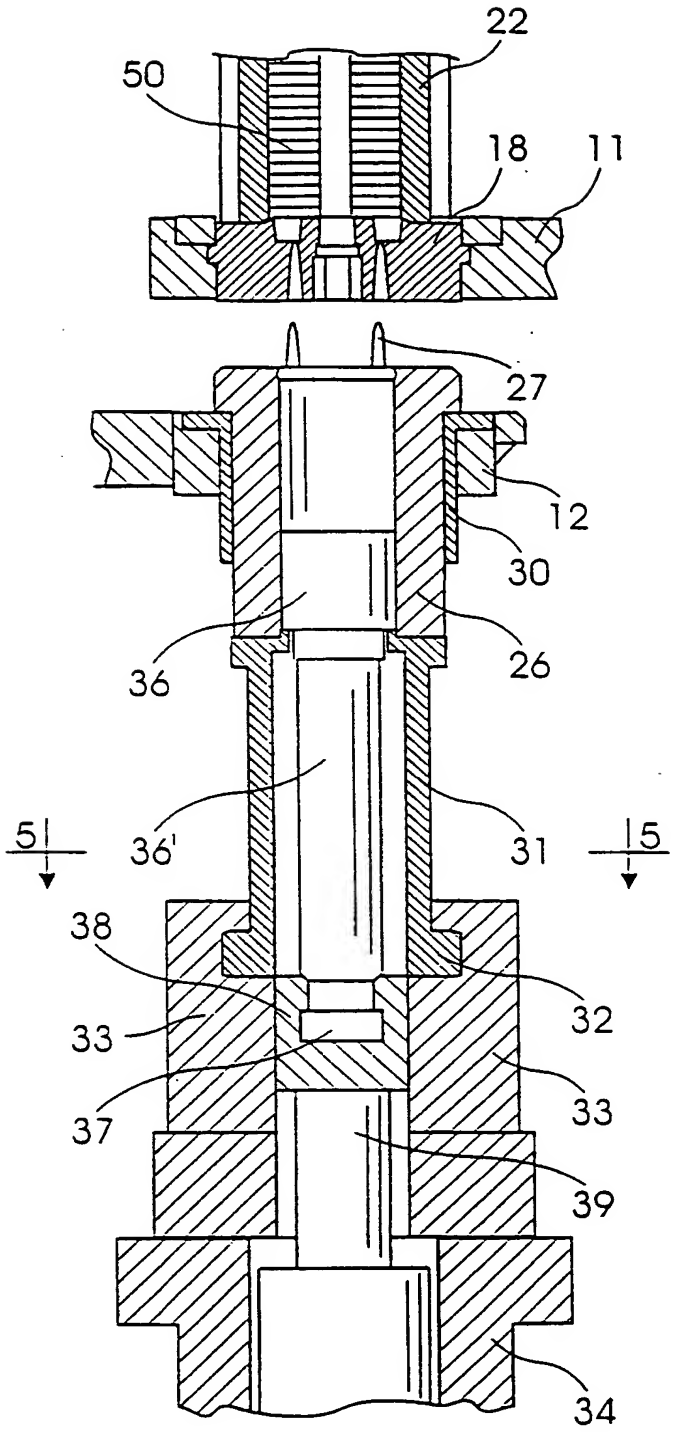

Fig. 3

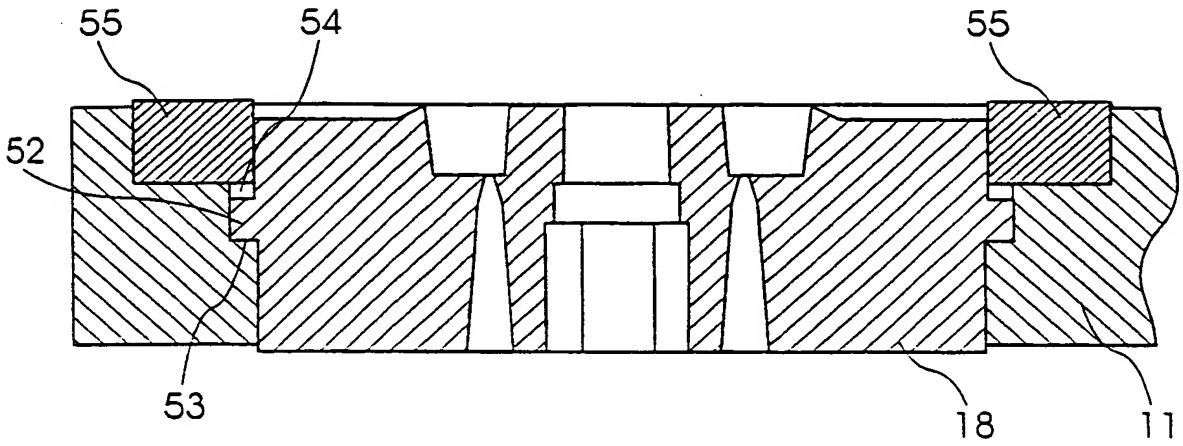

Fig. 4

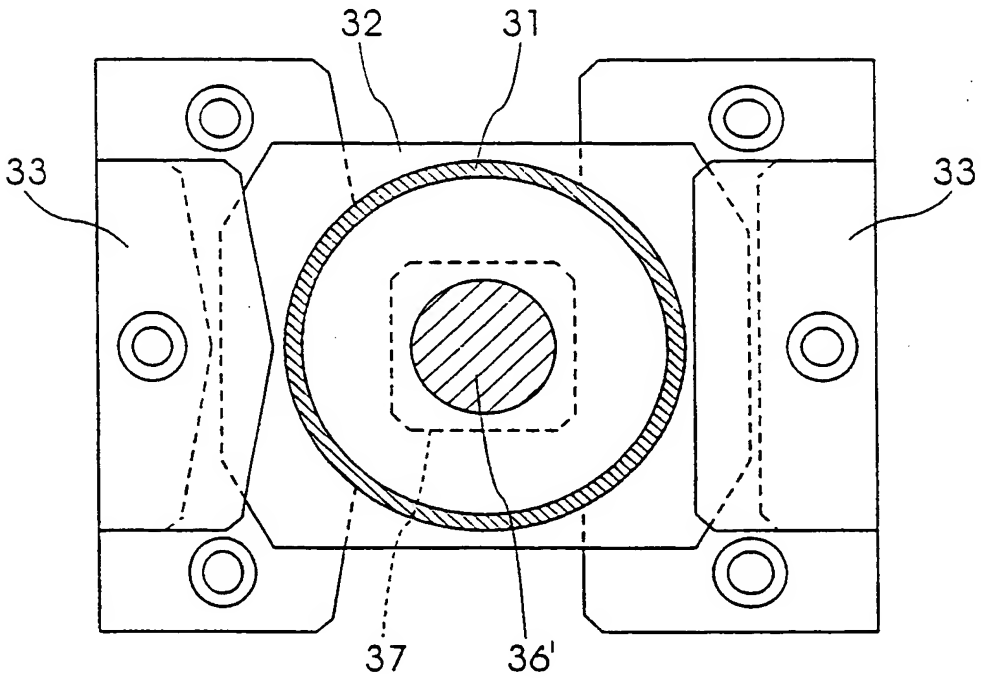

Fig. 5

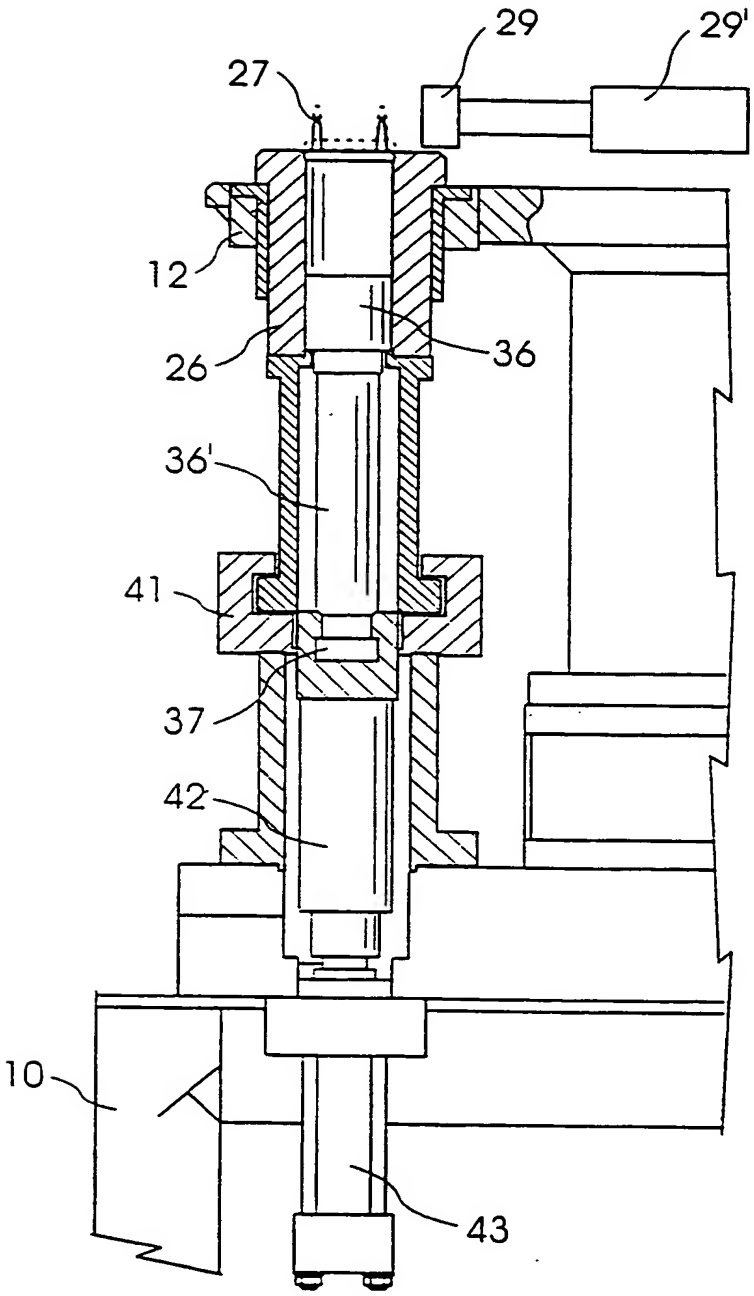

Fig. 6

INTERNATIONAL SEARCH REPORT

Inter. nal Application No
PCT/EP 00/06705

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B22D17/12 B29C45/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B22D B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
WPI Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 866 666 A (WUNDER WILLIAM G., HAMILTON, US) 18 February 1975 (1975-02-18) cited in the application column 2, line 55 -column 7, line 52 figures 2-11	1-13
A	US 5 660 223 A (THIEMAN TED H ET AL, DAYTON, US) 26 August 1997 (1997-08-26) cited in the application column 2, line 36 -column 5, line 20 figures 1-4	1-13

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 November 2000	01/12/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Peis, S

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Interr. nal Application No
PCT/EP 00/06705

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3866666 A	18-02-1975	US 3826302 A	30-07-1974
US 5660223 A	26-08-1997	IT T0960929 A	19-05-1998
		JP 9262654 A	07-10-1997